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ABSTRACT

Several things must be done before a critical mass of computer-based materials can form a library. Existing materials must be upgraded, and made accessible, flexible and customized for individual users. Their mobility must be increased by reconciling inter-system differences and by providing necessary skills, resources and reward structures. Essential to this is the involvement of a large body of "bridge personnel"--individuals with expertise in both subject matters and technical affairs who are capable of supplying the necessary systems maintenance. A staff of bridge personnel is usually too expensive for any single institution, leading to the conclusion that regionally shared networks, backed by state financing, is the best way to develop computer libraries. The North Carolina Educational Computing Service, funded by the state legislature and with 12 bridge personnel, offers services to 44 institutions of higher education and provides a good illustration of a successful regional operation. [Reproduced from best available copy.] (PB)

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A Further Evaluation of Bridge Roles

by

Joseph R. Denk

Regional and National Organizations
for Dissemination of Computer-Oriented Curriculum
Materials for Higher Education

Presented at
The AERA National Meeting
Symposium

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IMPROVING EDUCATION THROUGH COMPUTERS:
NATIONAL STRATEGIES FOR CHANGE

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A Further Evaluation of Bridge Roles:

Regional and National Organizations for Dissemination
of Computer-Oriented Curriculum Materials
for Higher Education

Despite the many attempts to make it seem that computer libraries should be equivalent to traditional libraries, no functional computer libraries for education have appeared which could in any way merit this equivalency. It may be that there just are not enough computer-based materials around to make the challenge. But before a critical mass of materials can form such a library, there exist several lacunae in the dissemination process which no longer exist for books. It is relatively easy to model the dissemination process for books with links between authors, publishers, reviewers, disseminators, more reviewers, and readers as well as feedback loops. For computer-based materials, the holes show up as interfaces which are problematic: all of education starts with reading but programming still is not part of everyone's training; reviewers lack skills or there are too few reviewers; the materials require much more support than shelf storage; books can contain logical errors not possible for programs; authors are all too few.

For higher education, both regional and national strategies have been pursued in attempts at filling some of the holes in the dissemination process. This paper is based on the author's involvement in a regional experiment[1] toward building a library of computer-based curriculum materials (paper attached) and a national experiment, CONDUIT.[2] From these two experiences, the lacunae is the dissemination process have become partially visible. Further, the nature of available resources for a computer-based library of curriculum materials have been noted as can be seen in the attached paper. For a learning resource of computer-based materials to become the equivalent of a college library, both the materials and the dissemination process require radical improvement.

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[1]The regional experiment is reported in the attached paper, "A Curriculum Applications Computer Library--Results of a Regional Development Model in North Carolina." This paper has been submitted to the Fourth Conference on Computers in Undergraduate Curricula, Claremont College, June, 1973.

[2]See reference three (3) in the attached paper.

Available computer based materials do not form an easily accessible, readily customized learning resource as the author envisions the future educational environment as a result of the presence of the computer. While a few materials are now available to meet this future possibility, the environment of most institutions cannot support these materials much less consider them for importation. Behind the constraints lies an absence of skills not financially obtainable at this time. Growth toward the ideal will involve bridge personnel--support careers all too common with emerging technology.

The Materials Available Today--Immobility and Immaturity

It is true that there are not enough available computer-based resources available to compete with a good college library. The HumRRO representatives of this session have looked hard to discover 8,000 packages--hardly a respectable library. The North Carolina Educational Computing Service has collected almost 2,000 packages in its regional attempt at library construction. A sparsity exists.

Yet the number of publications on computer-based instruction is growing steadily. Most of the materials involved are immobile. Not only are systems differences barriers toward mobility but the lack of skills, resources, and reward structure make the mobility even worse. Many of these mobility problems are solvable with bridge personnel--people with technical (computer) and substantive competence to do the job. But who can hire them? Some of the problems are solvable with careful authorship. Dartmouth's project COMPUTE, as reported by Luehrman in this symposium, is a partial answer to this problem.

It is almost an adage that all computer programs are obsolete at their completion. The exceptions are few and far between. Immaturity doesn't imply obsolesence. Rather, the absence of continual maintenance, support, and upgrading make most materials appear obsolete. Again only bridge personnel can provide enough competence for such continual support to prevent this premature obsolescence.

Missing characteristics in most of the materials available today are ease of access, flexibility, built-in customization for the individual, and transparancy. Immaturity, therefore, is measured against the learning resource ideal which the computer can and does supply in a very limited number of cases.

Since a number of materials show apparent maturity against this measure, the attainment of the ideal is possible. Unfortunately, financial support for producing such maturity has been severely limited and too often given by generalist functions of the federal government. As out-of-touch as this may seem, it will be profitable for discipline-oriented professional societies and federal agencies to sponsor team writing projects to meet this maturity rather than to leave the funding activity to a computer agency incapable of measuring maturity to sufficient substantive depth.

Regional Dissemination--Again the Bridge Personnel!

The author is convinced that no single institution can economically obtain, maintain, and upgrade an instructional library of computer-based materials. Faculty selection would have to keep this in mind and a massive user service department would have to be hired. The personnel requirements of the traditional library could be overshadowed! Sharing a common computer regionally with a large staff performing all of the supportive functions for many institutions is an obvious strategy.

Over 25 regional centers have been funded by the National Science Foundation to this purpose. A few have held on successfully. The largest curricular libraries have emerged from centers in which the support function has been supplied by bridge personnel competent with the computer, materials, and substantive issues. These personnel, aided much by faculty participation in technical and substantive transportability, are a sine-qua-non condition for providing absent technical skills to faculty and students, for providing support, maintenance, and upgrading with faculty and student feedback. Without them, the library cannot reach the maturity required of a learning resource.

Complicating the regional set-up is the absence of a mutually agreeable center and local funding for such activity. Competing computer configurations often allow no comprimise and the wheel is recreated poorly in several centers. State support from the legislature for a centralized library function has only occured, to the knowledge of the author, in North Carolina. Over one-half of the senior colleges and universities are linked to a central library supported by a State-funded group of bridge personnel. Over 20 community colleges and technical institutes also enjoy this State supported function.

With the hardware differences (both nationally and regionally) regional support seems the only possibility for acquisition of required bridge personnel. Where regional configurations are considerably varied, bridge roles are required to gear access by members of a single institution to several resources (like NERCOMP) or to help in the library construction at the various sites. Outside of State support, no other beneficent agency can be recommended for the broad needs of varying institutions and varying configurations.

National Dissemination--Playing the Publisher in Areas He Fears to Tread

So few library-worthy computer-based contributions have come from the commercial houses that the lacunae on the production end are observable. Review is weak or non-existent. The technical know-how is probably weak. Difficulties in copyrighting programs make the investment risk at best hazardous. What to support seems almost a mystery to most commercial houses.

CONDUIT, Computers at Oregon State University, NCECS, Dartmouth, and the Universities of Iowa and Texas, has been testing the transportability of computer-based curriculum materials between five regional centers. By supplying the review function through disciplinary committees, the technical transport via bridge personnel at the five regional centers, and coordination by a central agency, a parallel to commercial activity was tested.

The National Science Foundation has studied the possibilities of trying to link several computers in a machine-to-machine network. A definite possibility for the future, this mechanism is doomed to failure without sufficient provision for bridge personnel linking the user one-on-one to all library resources. Currently available materials neither lend themselves to accessibility nor flexibility without this personnel support. The problem remains--the library is still not available to the user community without significant support.

NCECS has found that the transportability problem falls more in the realm of pedagogical and substantive parameters than it does in the technical area. Bridge personnel are therefore required to be so strong in pedogogy and substance so as to provide an effective interface between the faculty and student users and the importable item. In the absence of commercial resources, the review problems complicate the requirements of these bridge personnel.

If federal agencies would like to make a major contribution to national dissemination, they are faced with this alternative: fund some representative or two in each institution of every State or help build centralized bridge staffs in several representative State. The author feels this is a problem for the State itself to support and that the federal agencies concentrate on long-range solutions such as computer linkage and the generation of super-systems inside of the disciplines. It is not conceivable that a people-to-people concept can be overcome with hardware connections.

Roles of the Bridge Personnel--Case Studies

Substantive and technical backgrounds together loom as essential pre-requisites for the bridge personnel. Add to this pedagogical know-how and the library has got a chance. In the absence of flexible, adaptable, and sufficient materials coupled with a low level of technical skills in faculty and students, someone has to supply the interfaces required.

A self-instructional biology package appears at the University of Iowa. Only one biology teacher at the interested college has any competence in the area and he foresees a year to put the materials on the system. Since his is overloaded and cannot find students for the job, who does it?

Somehow a set of drills for freshman chemistry become mounted on a campus computer system. In the middle of testing these materials with a sample of students, one professor is flooded with complaints that the drills bomb-out at a certain point without reason. His tests bear this out and his computer competence is low. Who fixes the problem?

Professor Y plans to use a business game with one class and is offended by the manner in which the program handles the marketing function. No other game fits his class level so he looks to improve the model. He gets it done in one semester at the sacrifice of one publication only to find he did not take enough consideration of the other variables in question. Who addresses this non-functionability?

The social scientist at Z college are really hung-up on survey analysis. Having access to a superb statistics package, they assign hypothesis testing to several introductory courses. In one week the students are bored with the limited data available. How does he get more?

A university decides to install an interdisciplinary course involving ecology and simulations. They would like to play 10 games. Resources show only one relevant game on the system. Who gets nine more?

A Library--Flexibility and the Expensive Future

One advantage of a book library is that garbage can be absorbed in space as easily as great works. As a matter of fact, this is desirable for open-ended learning as a resource for the resource director. How many computer-based materials can a library support to give the resource flexibility? Who will want to call the limits on computer-based resources?

Fortunately, commercial ventures help in the sifting process. The problem is not hopeless but looks prohibitively expensive. In less than a decade, a critical mass of computer based tools with sufficient flexibility should be available to the general public to meet a significant percentage of learning resource needs. For most locations it won't happen. For the few, it will occur as the result of the presence of regional support for storage, maintenance, and upgrading but most of all because of foresighted centralization of key bridge personnel. Even the maturity of materials will be hastened as the result of the interaction of these bridge people with faculty and students.

A Curriculum Applications Computer Library-

Results of a Regional Development Model

In North Carolina

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"We support all of the curriculum software deemed necessary for undergraduate education - SPSS and TSAR"

From a brochure of a University Computer Center.

The introductory quote shouldn't be understood as only a lack of knowledge of educational software. It illustrates that the term "support" is loaded with factors that may well challenge the relevancy of applications programs for education both as to their inherent value and their cost effectiveness. What should be challenged in such a statement is the rationale behind its publication if it is not made in ignorance. Has the center data which shows that further software is questionable as to educational validity? Are the support requirements for applications programs prohibitively expensive in light of their usage? Does this center exert a tight control over its library because of budget constraints on computer usage, personnel for development, or user service consultation? Are the faculty and student users powerless or disinterested?

In 1969, a specific model for developing a curriculum applications library was undertaken by the North Carolina Educational Computing Service, NCECS, in order to promote curriculum enhancement via computer for remote institutions sharing a network computer. The model stemmed from the author of this paper who had previously been a remote user and had faced such an apparent poverty of

supported applications software as is illustrated in the introductory quote. All of the factors mentioned in the preceeding paragraph seemed to be possible contributions to the gap between the demands of faculty and students for applications and the questionably few "library" holdings of the large central computer. But additional reasons for constructing the model included the apparent low level of the state of the art and the growing knowledge of applications software development in other parts of the country. The model was to be a test of the relevancy of supporting a library in light of the barriers described above.

While the construction of the model was published six months after its birth at an earlier conference,[1] a summary of this construction and its limitations must be given so that the results of three and one-half years of its operation can be analyzed. Basically, the model involved a centralized collection of curriculum applications of the computer, an exposure of this collection to faculty and students, and increasing support level given to those applications which elicited interest from faculty and students. Thus a library of supported applications would evolve from the user and usage of the library would provide a further sifting process.

Essential to the communications involved in the model was a current awareness journal (published seven times) called Program and Literature Service, PALS.[2] The structure of the program section of PALS, seen in Figure 1, clarifies the model structure by classifying each entry according to the support level it has reached. Section I of PALS deals with programs, section II with related literature reviews. Program entities (or curriculum applications) in section I are categorized by support into A, B, and C. IC entries contain those talked about in any form of publication, i.e., the "rich array." All that NCECS has on these programs is talk - no listings, decks, or other functional modules. IB entries are programs which have come into the hands of NCECS and reside in a "Limbo". IA entries have reached library status or full support.

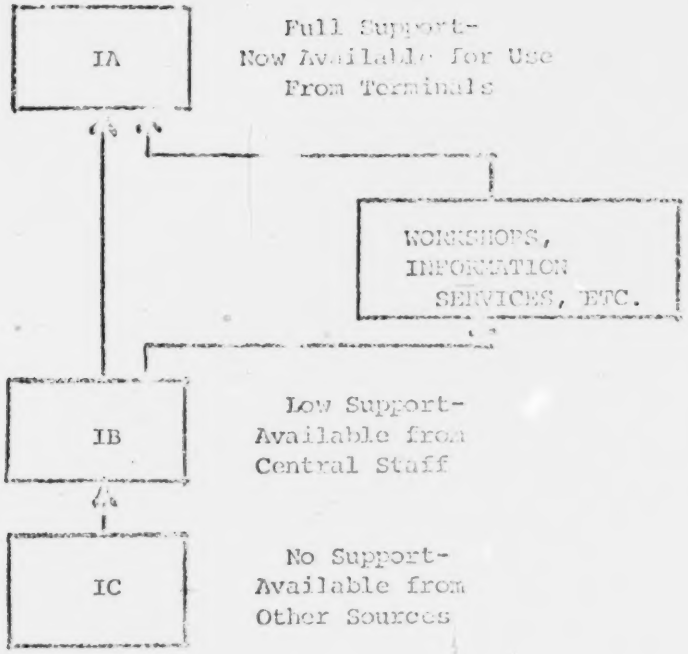

FIGURE 1.

Bringing materials to full support involved workshops (State-wide and regional), a program for supporting faculty to bring imported materials to full support or to create new materials, and a heavy load of central staff effort in moving materials directly to full support when the materials seemed to warrant this bias. Thus, the "workshop, Information Services, Etc." path to full support had a by-pass which makes the resulting library only partially elicited from North Carolina faculty. The results, therefore, reflect a mixture of in-State interest and out-of-State indicators.

RESULTS OF THE MODEL IN NUMBERS

Over 3,000 program entities were heard of by NCECS. Therefore, the "rich array" brought this number to the IC level of support or no support. Collection activity herded over 1,500 into the hands of NCECS in some shape, i.e., the IB category of low support. The seventh issue of PALS numbered 381 of these programs in the IA or full support category. Of this resultant library of 381 entities, we know of some kind of usage of the programs by faculty or students for 320 of the 381 under full support.

The seventh issue of PALS reflects a further sifting process. In addition to the 381 programs in IA, 367 are listed in IB and 180 in IC. Thus, only 748 of the 1,100 collected are still being talked about as available and 180 of the "rich array" are still being referenced. Lack of interest, garbage-like quality, and non-functionality are among the factors causing this further sifting to one-half of the programs originally available.

LIMITATIONS OF THE MODEL - ITS ENVIRONMENT

At the center of the regional network of NCECS is an IBM 370 Model 165. This computer is owned and serves the three triangle universities, North Carolina at Chapel Hill, North Carolina State, and Duke. The regional network, NCECS, has 41 colleges (also 10 high schools) and represents a fourth user group to this central computer. Of the 44 colleges and universities, 23 are community colleges and technical institutes.

The Triangle Univeristies Computation Center, TUCC, offers both remote job entry (RJE) and interactive processing.[3] Included in the interactive services are programming systems employed BASIC, PL/1, and APL. TSO is also operational at TUCC. Through RJE a large array of compilers is available including FORTRAN IV, PL/1, COBOL, ALGOL, PL/C, WATFIV, and WATBOL. About 25 percent of the jobs at TUCC are interactive processing.

Terminals to TUCC include the IBM 1050, 1130, 2741, 2770, and 2780, teletypes, DATA 100, UCC 1280, "Perry Terminal", and DATEL (2741 equivalent). Many of these terminals allow no usage of interactive facilities, these being low to medium-speed batch terminals. Only one installation multiplexes teletypes through a DATA 100 terminal.

This rough sketch of the network configuration hopefully brings to light several limitations of the model. A very large population of potential users

is involved: over 110,000 students and some 7,000 faculty. With this large population and the variety of institutions and terminals, adoption of a package by one user has a significantly greater probability than would be had if a single institution represented the population. The limitation to many of these users of RJE facilities only and an IBM machine colors the resulting library. A further consideration before analyzing the results of the model is the age of the network; it is 6 years old. Therefore, package adoption shouldn't have been seriously hampered by the technical problems of newly established and buggy facilities.

Probably the major considerations which must be understood are the funding and staffing requirements behind the model. After 43 institutions got terminal access to TUCC via private funds during 1966-1969, the National Science Foundation funded the network staff of 12 and its function for 3 years, 1969-1972. The Legislature of the State of North Carolina funds the 12-man staff and its function since 1972.

The NCECS staff of 12 provides consultation for terminal installation or upgrading user services for the network with special emphasis on curriculum-oriented packages, transportability and support of applications software, and information services. No systems support is required of this staff since this is a function of the TUCC organization. The rather large staffing requirements together with the active role of over 50 funded faculty members as consultants puts in the light these most serious limitations to replicating such a model.

OPERATION OF THE MODEL

Moving a program to full support required, according to the model, two basic steps: collection of materials, and "marketing" the materials for acceptance. Collection was a combination of staff efforts and results of supported efforts from representative faculty. Over 40 funded projects supported a significant

faculty representation in this phase. This combination provided not only a revicwing process by discipline-oriented faculty, but significant consultation on implementation. In the collection process, materials had to undergo some initial support in order to prepare for marketing. Collection, therefore, represented "transportability" of curriculum materials.

CONDUIT activity[4] produced 77 of the 381 programs in the resultant library but only 30 of these programs have found classroom usage at this writing. Of the 77 CONDUIT additions to NCRCS, 50 were already in IB status before the existence of CONDUIT.

The second basic step, marketing, could be summarized operationally as workshops, information services, workshops, circuit riding activity, and more workshops. NCRCS ran 44 workshops which were typically 2-day sessions involving 35 participants. Over 1,500 participants represented 850 people (a typical participant came again). These workshops averaged a cost of $1,000 to $1,500.

It is importatnt to see the staffing link in the marketing function. A library resulting from such a model has a large dimension of technical support behind initial training and ultimate acceptance. This will be treated in depth in the last section of this paper. It is this unknown that will most color any resulting library.

Marketing therefore involved a large staff which workshopped on State-wide, regional, or institutional level. The circuit riding function supplied a mechanism which increased adoption probability because of the one-on-one training in the trainees' own shop. Reduction of technical barriers to a minimum was a purpose of this mechanism.

THE RESULTING LIBRARY

Having described the model and its limitations, we now will try to look at the resulting library, the IA section of PALS. The canned programs that have

emerged as fully supported cannot be treated individually but an analysis of the library sections by discipline provides overall results that make the construction of a library from scratch easier to conceive. Categorization of types of computer usage has been accomplished in the abstract,[5] but the emergence of certain types in each discipline may provide more information as to directions of library construction.

ACCOUNTING: The PILLSBURY package[6] and a bevy of 20 canned batch programs for introductory principles of accounting[7] pretty well represent the library to date. It can be characterized as an entirely batch-oriented library. The absence of interactive canned programs could be a result of the fact that no marketing has been done in this area despite the availability of such a package[8] from the Georgia network. It could also be due to large classes and concomitant expenses in accounting courses especially at the introductory level.

The resulting library uses the computer more for data processing rather than for any other type of usage. Pillsbury's package is the most widely adopted undergraduate canned package known. A few other packages have recently emerged which are supposed to challenge PILLSBURY both substatively and pedagogically but no such widespread adoption has as yet occurred. The package is a good start for any batch oriented system. More sophisticated usage of the computer than this data processing approach (such as simulation, data reduction, etc.) may be good for upper level courses but have not emerged as popular in this discipline.

BIOLOGY: The NCECS library for biology is modular and almost entirely composed of simulation and data reduction cans. Almost all of the entries point to laboratory work, both dry and wet varieties. Genetics, ecology, and population seem to be the dominant themes. Small statistical routines dot the entire map and the mathematical depth of most of the models is not very sophisticated.

Anyone can speculate on the reticence of biologists in entering mathematical-computation-computer techniques. The real story is that there are very few

packages available. Outside of the University of Iowa writing project[9] and a smattering of applications reported in this series of conferences, available pickings are few and far between. However, the impact of these small simulations and data reduction routines is not low. A library would do well to begin with a half-dozen simulations. The lower sophistication and good documentation of these modules considerably lessens the pedagogical burden of the usage of such approaches as simulation in lower level courses.

These modules usually can operate equally well in batch or interactive usage. Most seem better suited and actually find more adoption in the interactive mode.

BUSINESS: The business library resulted almost entirely in batch-oriented simulation models. A variety of business games are supported ranging in sophistication from "The Executive Game - TEXG"[10] (lower level but easier to manage educationally) to INTOP[11] (sophisticated but extremely difficult to implement on the undergraduate level[12]). Almost 50 modules appear which can be classified as case study approaches to business or finance. No interactive programs appeared.

Business games definitely get adopted and should be among the library holdings. However, the variety brings with it many support problems. The vast majority of usage occurred with the easiest-to-use game, TEXG. After that, one or two users at the most appeared for the other games. Probably the fact mainly responsible for these results is that the marketing function of the staff concentrated almost exclusively on TEXG. Yet, the disbelievers in any one game as not sophisticated enough are constantly faced with the managerial problems of big games like INTOP. National adoption patterns place TEXG almost as popular as the PILLSBURY package for undergraduate implementation.

Case study models involve three notable packages: LERNER[13], WHYBARK[14], and HARRIS[15] (the last two being CONDUIT-tested packages). Finance and Operations

Management are the basic areas of interest and all of the 44 programs are batch-oriented open-ended models.

The high frequency of the use of simulation in business may well be inherent to the teaching of the discipline. It could also be that other modes of computer usage are not marketed. The absence of interactive mode usage seems to stem from the time necessary for decision making by users. This must be taken with caution since interactive finance packages are available at centers with high concentration on time-sharing. Dartmouth's school of business concentrates on time-sharing and the student activity of programming rather than on the use of canned programs.[16,17]

CHEMISTRY: It is questionable whether the 49 programs modules under full support in the NCECS library represent the most desirable programs of the 135 available in PALS IA and IB. The use of canned programs in Chemistry (and the other physical sciences) is not nearly as extensive as in the business and social science curricula. No integrated packages or systems seem available as they are in these other disciplines. While almost all possible modes of computer usage are available in this modules, including simulation, data reduction, information retrieval, problem solving, data acquisition, drill and practice, and graphics, chemists seem to prefer to program their own solutions to the majority of their undergraduate problems. This result came despite the availability of the largest (in numbers) collection of canned programs in chemistry.

Interactive vs. batch usage seem irrelevant to consider in the wealth of applications available. Many of the programs have built-in interactive needs; many cannot work interactively.

CONDUIT reflected the modular result by testing the transportability of 37 modules.[18] Many modules are adoptable as subroutines toward the solution of a variety of problems and do find usage in this manner. It should be concluded that canned programs should be a part of the resulting library. Isolation of a reasonable number is problematic.

ECONOMICS: For a discipline so natural to the use of simulations and data analysis, economics proved difficult in the indentification of representative library members. Even after CONDUIT activity, the resulting library still holds only 8 entities, most of which are macro and micro models. Not that there is a deficiency of available materials! Some 54 entries in all are mentioned in PALS. There seems to exist such a deep knowledge and probably healthy mistrust of available models which prevents any unanimity of opinion. NCECS's library reflects a conservative hesitation as to which models deserve full support.

The principal category of computer usage is relatively easy to spot, however, and that is simulation. While the resulting mix is principally batch-made usage of the computer, two interactive programs have been used. No marketing on an available broad library of interactive programs[19] could be the principal reason behind this. CONDUIT contributions[20] were also primarily batch-oriented.

Simulation is not the only category of usage in economics. A macroeconomics data base for use with SPSS has been put in the form of a student manual[21] at the Social Science Archives of the University of Iowa. Dartmouth College has implemented data analysis in time-sharing. Like some others, Treyz's work[22] at the University of Massachusetts involves students in the programming of models.

MATHEMATICS: Although the NCECS fully supported library has 15 programs in Mathematics, none of these are recommended for beginning a library. Canned programs almost seem an anathema to mathematicians who really do not look for solutions but concentrate on methods of solution. The canned programs in NCECS's library are used by people in all disciplines and rarely by mathematicians. Basically, they are routines from IBM's Scientific Subroutine Package.

Earlier efforts at calculus like CRICISAM[23] proved to be too much computer and too much calculus. Dartmouth's project COEXIST[5] concentrated on students writing programs to solve mathematical problems. A writing project at the University of Iowa built materials directed toward student programming with the

help of a few provided subroutines whose reproduction seems irrelevant to education. This project produced among others, a package for linear Algebra[24]. Batch vs. interactive modes of usage seem irrelevant to mathematics as far as building a library. Canned programs for a mathematics library seems to be a relatively futile investment.

PHYSICS: Physics, like chemistry, has shown only a limited interest in canned programs. The KCMCS library contains 11 program entries, most of which were published in the well-distributed anthology by the Commission of College Physics[25]. These are only rarely used. Programming by students to solve physics problems seems to be preferable educationally than the use of canned programs. There are a few exceptions and it is also true that the sample of programs available may not have been all that great. The COEXIST materials[5] (tested by CONDUIT) are all directed at student programming but sometimes are implemented with canned programs (a tape of canned programs even comes with the materials). Some attempts have been made in this discipline also to can certain subroutines that are core to many problems. In physics problems, integration often provides this core, and numerical methods for solution of problems provide the canned programs[26].

Any attempt at discovering whether the batch or interactive mode is preferable is irrelevant in physics. The applications of the computer in physics cover every known category of usage. Yet with the endless applications, selection of canned programs for beginning a library is as problematic as in the case for chemistry.

POLITICAL SCIENCE AND SOCIOLOGY: These disciplines are not grouped together in PALS but are here for their common high dependency on the usage of canned programs and the parallels in the categories of usage that are popular. Survey analysis, simulation and the use

of statistical packages are in demand in both disciplines. The social sciences have accelerated in the use of canned programs in the undergraduate curricula compared to the physical sciences.

The NCECS library for survey analysis focused on a version of Dartmouth's project IMPRESS for the interactive mode, called POISSON[27], and SPSS. CONDUIT activity greatly enhanced the data base holdings for both of these systems by concentrating on the transportability of data bases. Student manuals for use by SPSS with specific data sets have been built at the University of Iowa under the direction of G. R. Boynton[28].

Simulation holdings in political science are the computerized Inter-National Simulation (INS)[29], SIMSTATE (simulation of a state economy), and PRIME (a simulation of international relations). Seven simulations are supported under sociology involving exchange theory, community land use, city growth, ecology, demography and welfare problems. All of these social science simulations find less usage in education than does survey analysis. It is believed that factors influencing this lower popularity include their difficulty in implementation, their inherent weaknesses, the absence of substantive and educational validity in these models, and the disproportionate time requirements for usage. Regardless of these difficult barriers, a variety of these simulations create significant faculty interest and some limited usage.

Batch mode computing dominates these holdings but interactive usage grows with the availability of such service. There seem to be no real rationale for a preference here.

PSYCHOLOGY: Experimental design via simulation and the use of canned statistics programs are the only psychology mentionables in the NCECS library. The former has been well reported in this series of conferences, the last of which is referenced.[31] EXPERSIM, a development of super-system for this purpose developed at the University of Michigan, is a monitor for running canned

experiments and for creating your own. Both interactive and batch usage have occurred, the former seeming to be preferable.

STATISTICS: There is no substitute for canned programs in teaching or using statistics. The NCECS library is loaded with both interactive and batch systems.

A CAUTIOUS OVERVIEW OF THE RESULTS

This model suggests that a library of canned programs for computer-based instruction is a realistic investment. Note that none of these programs can be truly classified as computer-assisted instruction, CAI, which approach definitely requires a library.

If the library is a reasonable investment, then it should have a heavy impact. The NCECS population served by the resulting library was very large and only about half of the 381 fully supported programs were adopted by two or more institutions of the 44 served. Further, only a few packages (e.g., PILLSBURY, TEXG, and POISSON) were adopted by more than 10 institutions. The impact of the entire library is therefore considerably limited if any single institution in the network is considered.

In order to better define the areas of best possible impact for such a library, the results of the model can be used to relate certain parameters treated in the previous section. Emphasis on disciplines with a higher canned program requirement is advisable. Further, programs that have proven educational acceptance would enhance impact. Selection of programs should be qualified with in-depth look at educational validity, cost of implementation, cost of usage, and ease of usage.

These parameters can be related by looking at a spectrum of estimated dependency on canned programs in the discipline's studied. Programs which have produced indicators of more impact can also be associated with this scale. Figure 2 represents as estimation of these parameters as a result of the NCECS model.

From Figure 2, the social sciences and business related curricula promise more impact than the physical sciences and math. Scaling of discipline inside these groupings are rough guesstimates but the differences have been noted.

THE BIGGEST PARAMETER -- THE SUPPORT FUNCTION

All of the results pointing toward some optimal library are useless without a very strong support function. The 12-man NCECS staff dedicated to applications software is not easy justified in any single institution. Involvement of this staff in the marketing function was a sine-qua-non condition before any faculty acceptance could occur. Even this staff's priorities placed some materials in a better position with respect to other possibly more acceptable materials. It could be that this support function may be the single most important factor. Great materials are useless without it.

Regional activity makes possible State funding for the support function as is the case in North Carolina. Any institution or regional center must consider a comparable funding source before the library will have an impact. Almost every institution or regional center fails in properly preparing for this activity.

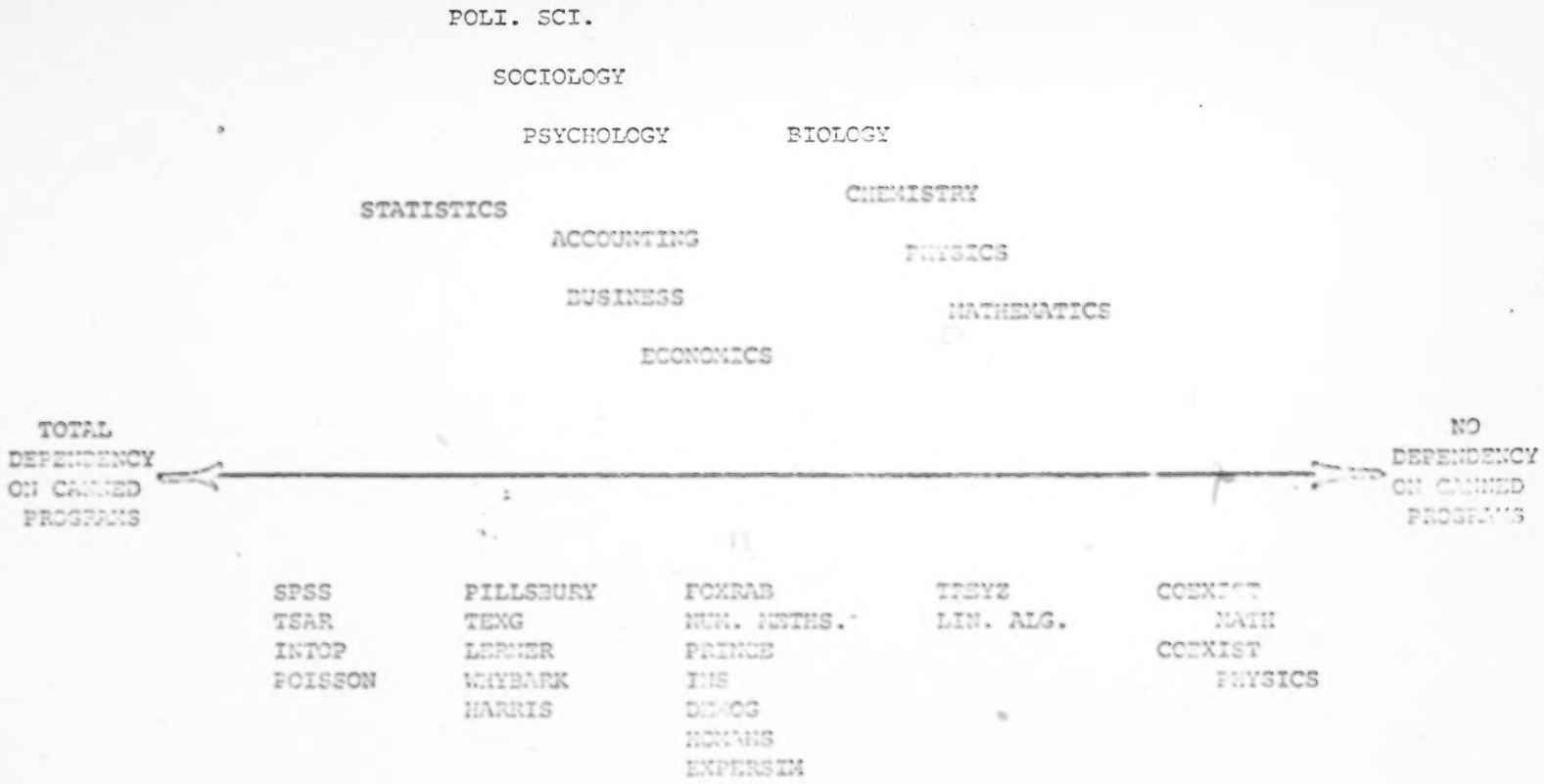
POLI. SCI.
SOCIOLOGY
PSYCHOLOGY
BIOLOGY
STATISTICS
CHEMISTRY
ACCOUNTING
PHYSICS
BUSINESS
MATHEMATICS
ECONOMICS
TOTAL DEPENDENCY ON CALLED PROGRAMS
NO DEPENDENCY ON CALLED PROGRAMS
SPSS
TSAR
INTOP
POISSON
PILLSBURY
TEXG
LERNER
WHYBARK
HARRIS
FORRAB
NUM. METHS.
PRINOB
IMS
DEMOG
HOWARD
EXPERSEM
TREYZ
LIN. ALG.
COEXIST
MATH
COEXIST
PHYSICS

FIGURE 2

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